Method for Forming DRAM Cell Bit Line and Bit Line Contact Structure

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to the manufacture of a dynamic random access memory (DRAM), and more specifically to the formation of a DRAM bit line and bit line contact structure.

2. Description of the Prior Art

In the manufacture of semiconductors, conducting wires and conducting wire contacts are used in large quantities. In DRAM manufacture, a contact window is formed in a cell structure, in which a polycrystal material is filled to form a plug, and the chemical mechanical polishing (CMP) is performed to constitute a bit line contact. The structure obtained from this stage is substantially similar to that in Figure 2a. In the current manufacture process, however, the bit line contact formed has a large contact area. With DRAM becoming more and more compact, the interval between bit lines becomes narrower and narrower. Referring to Figure 1, when the bit line contact 12 has a large contact area, the bit line 11 has a poor coverage to the bit line contact 12. If one bit line is slightly inclined, it is likely to cause an improper bridging, leading to an abnormal short circuit between bit lines. Therefore, a

solution is needed to overcome this problem.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a method for forming a bit line contact structure, making the formed bit line contact have a small contact area.

Another object of the present invention is to provide a method for forming a bit line and bit line contact structure, which can improve the coverage of bit line to bit line contact so as to avoid the improper short circuit between bit lines.

According to an aspect of the present invention, a bit line contact structure forming method, based on a semi-finished product structure whose contact window has been filled with a polycrystal plug (hereafter, the "poly plug"), comprises the following steps: removing some of the oxide layer to make the plug protrude; oxidizing of the exposed region of the protruding portion of the plug, and removing the oxidized portion of the plug.

According to another aspect of the present invention, a bit line and bit line contact structure forming method, based on a semi-finished product structure whose contact window has been filled with a poly plug, comprises the following steps: removing some of the oxide layer to make the plug protrude; oxidizing the exposed region of the protruding portion of the plug; removing the oxidized portion of the plug; forming a first dielectric layer on the upper surface of the entire structure, wherein the upper surface of the plug is exposed; forming a second dielectric layer on the upper surface of the first

dielectric layer including the upper surface of the plug; coating photoresist on the second dielectric layer and performing exposing, developing and etching to form a trench of a predetermined pattern; and filling metal in the trench to form a bit line.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a schematic diagram showing the coverage of DRAM bit line to bit line contact in prior art;

Figures 2a to 2g are cross sectional diagrams illustrating the steps of the present invention; and

Figure 3 is a schematic diagram showing the coverage of the bit line to bit line contact formed in the present invention.

DETIALED DESCRIPTION OF THE PREFERRED EMBODIMENT

Figure 2a shows a partial cross sectional diagram of the structure of a dynamic random access memory (DRAM) cell semi-finished product, wherein reference number 20 represents a substrate, 22 is a poly plug and 24 is an oxide layer. In this figure, the poly plug 22 has been inserted in a contact window. The upper surface of the structure can be planarized by chemical mechanical polishing (CMP).

Referring to Figure 2b, some of the oxide layer 24 is removed by wet

etching or dry etching so that the poly plug 22 protrudes.

Then, the exposed region of the protruding portion of the poly plug 22 is oxidized so that an oxidized portion 23 is formed, as shown in Figure 2c. The oxidation treatment can be carried out by any proper means.

Subsequently, the oxidized portion 23 of the poly plug 22 is removed by a proper removing method such as wet etching, as shown in Figure 2d.

Referring to figure 2e, after the oxidized portion 23 of the poly plug 22 is removed, a first dielectric layer 26 is deposited on the entire structure. The material of the first dielectric layer 26 can be SiN, SiON or any proper material. The upper surface of the poly plug 22 is exposed. The surface of the entire structure can be planarized by CMP. The first dielectric layer 26 can serve as a stop layer for the planarization.

Then, a second dielectric layer 28 is deposited on the first dielectric layer 26, as shown in Figure 2f. The second dielectric layer 28 can be an oxide layer. Perferably, the material of the second dielectric layer 28 is different from that of the first dielectric layer 26. When the materials of the first and second dielectric layers differ from each other, the first dielectric layer 26 can serve as the etching stop layer for subsequent manufacturing steps for the bit line. However, it is also possible to use a material which is the same as that of the first dielectric layer 26 for the second dielectric layer 28, and the method of the present invention is also applicable.

Then follows the common bit line manufacturing process. Photoresist is formed on the second dielectric layer 28 to from a photo mask. After exposing, developing and etching processes, trenches with predetermined patterns are formed in the second dielectric layer 28. Then, metal is filled in

the trenches to form bit lines. Finally, the photoresist is removed. As mentioned above, the first dielectric layer 26 can serve as a stop layer at the time when trenches are formed.

Figure 2g shows the structure after the photoresist has been removed. This figure is a cross sectional diagram taken from the section of the bit line. In the figure, reference number 29 represents the section that constitutes the bit line. The material of the bit line can be copper, tungsten or any proper material.

As shown in the figures, the upper surface area of the poly plug 22 in the structure formed by the method of the present invention is small as compared to the prior art, that is, the critical dimension of the bit line contact becomes small. As shown in Figure 3, since the upper surface area of the bit line contact becomes small, the coverage of the bit line to bit line contact is improved. Hence there is a large margin for the interval between the bit lines. In this case, a short circuit will not occur even if the bit line is slightly curved.

While the embodiment of the present invention is illustrated and described, various modifications and alterations can be made by persons skilled in this art. The embodiment of the present invention is therefore described in an illustrative but not restrictive sense. It is intended that the present invention may not be limited to the particular forms as illustrated, and that all modifications which maintain the spirit and realm of the present invention are within the scope as defined in the appended claims.